

# NAVY EXPERIMENTAL DIVING UNIT



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# **DEPARTMENT OF THE NAVY NAVY EXPERIMENTAL DIVING UNIT**

PANAMA CITY, FLORIDA 32407-5001

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REPORT NO. 3-92

ELECTROCARDIOGRAPHIC MONITORING DURING HYPERBARIC MEDICAL TREATMENTS USING A THROUGH HULL ELECTRICAL PENETRATOR

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> > DECEMBER 1992

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

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REPORT DOCUMENTATION PAGE			
1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT  DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NEDU REPORT No. 3-92	5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZ. 6b. OFFICE SYMBOL (If applicable) Navy Experimental Diving Unit 02	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code)	7b. ADDRESS (City, State, and ZIP Code)		
Panama City, Fl 32407-7015			
8a. NAME OF FUNDING/SPONSORING 6b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
Naval Sea Systems Command 00C			
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS		
Department of the Navy Washington, D.C. 20362-5101	PROGRAM PROJECT NO. TASK NO. WORK UNIT ACCESSION NO.		
11. TITLE (Include Security Classification)			
(U) Electrocardiographic Monitoring During Hyperbaric Medical Treatments Using a Through Hull Penetrator			
12. PERSONAL AUTHOR(S) GIEDRAITIS, R.B.; McCARTHY, JAMES W.; BRAUN, JAMES R.			
13a. TYPE OF REPORT 13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day) 15. PAGE COUNT		
FINAL FROMTO	DECEMBER 1992 9		
16. SUPPLEMENTARY NOTATION			
17.   COSATI CODES   18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)			
electrocardiographic, ECG, electrical hull penetrator, hyperbaric			
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
Continuous electrocardiographic (ECG) monitoring of a seriously injured patient during a hyperbaric treatment is a useful means of assessing the patient's cardiac status. Using standard off-the-shelf components, a hull electrical penetrator assembly was designed and tested at the Navy Experimental Diving Unit. The assembly met all performance and safety criteria. This report details the wiring diagram to support the installation of a Conax 3/4-inch NPT full coupling hull penetrator for ECG monitoring.			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT 21. ABSTRACT SECURITY CLASSIFICATION			
UNCLASSIFIED/UNLIMITED X SAME AS RPT. DT	IC USERS Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL NEDU Librarian	22b. TELEPHONE (Include Area Code) 22c. OFFICE SYMBOL 904-234-4351		

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### I. INTRODUCTION

The safe application of continuous electrocardiographic (ECG) monitoring of a seriously injured patient during a hyperbaric treatment is a useful means of assessing the patient's cardiac status. Because of elevated partial pressures of oxygen at depth, the use of ECG monitors inside the chamber is a potential fire risk. Reference (a) recommends that every effort should be made to remove flammable and hazardous materials from the chamber. Reference (b) also warns against the use of the Lifepak monitor in potentially explosive or flammable environments. In addition, mercury contained within the monitor's cathode ray tube is a potential contaminant to the chamber environment and cannot be allowed inside.

To circumvent the potential hazards of using the ECG monitor inside the chamber at depth, a through hull penetrator can be used to connect the monitor from outside the chamber to leads attached to the patient inside the chamber. The Likfepak 5, 6, and 9 are discussed in this report as they are the most widely used ECG monitors in the U.S. Navy, but the same techniques can be adapted for use with other monitors. This paper will not address the use of the Lifepak 5, 6, or 9 as a defibrillator in the hyperbaric environment.

Because of the many configurations of recompression chambers in existence, along with the wide variety of sizes and physical locations of through hull penetrators, the exact selection of parts for every chamber cannot be made. The actual wiring diagram in Appendix A supports the installation of a Conax 3/4-inch NPT full coupling hull penetrator. If the chamber has a larger size hull penetrator than 3/4 inch, the use of a reducing bushing, both inside and outside to facilitate the use of this design is permissible. If the chamber has a 1/2-inch hull penetrator, use the Conax Connector, part number PL-18-4B in place of the Conax PL-18-12B.

#### II. METHODS

#### A. EQUIPMENT

1. Electrical connector (Model PL-18-12B, Conax, Amron International)

Pressure specification: Vacuum - 2500 psi

Rated: 600 volts to 85 amps

2. Utility Boxes (quantity 2): BUD P/N CU-234.

3. Inside Receptacle: (Model P/N 801050-02, Physio-Control) for mating inside the

chamber with EKG cable assembly (Model P/N 9-10418-02, Physio-Control).

4. External Receptacle: Standard three conductor audio receptacle (P/N 12B

Switchcraft) for mating outside the chamber with monitor cable assembly (Model

P/N SVC-C-409).

5. Three-fourths inch electrical conduit locking nuts (quantity 4).

6. Three-fourths inch short pipe nipple.

A supplier source list is included in Appendix B.

## B. ACQUISITION AND INSTALLATION

Installation of the penetrator to the chamber and its connection to the utility boxes will require hand tools. Soldering of wire connections will be required. Questions regarding the installation of the system or modification for monitors can be directed to the Hyperbaric Department, Navy Experimental Diving Unit (phone: 904-230-3100 or DSN 436-4351).

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## III. CONCLUSIONS

NEDU, using standard off-the-shelf components, designed a hull electrical penetrator assembly for electrocardiographic (ECG) monitoring. The assembly was tested and it met all performance and safety criteria. This chamber modification will allow ECG monitoring of a patient during treatment in a hyperbaric chamber.

# REFERENCES

- 1. U.S. Navy Diving and Hyperbaric Systems Safety Certification Manual, Appendix B; NAVSEA 1987, SS521-AA-MAN-010.
- 2. Lifepak 5 Operating and Service Manual, 1988; Physio Control, Redmond, Washington.

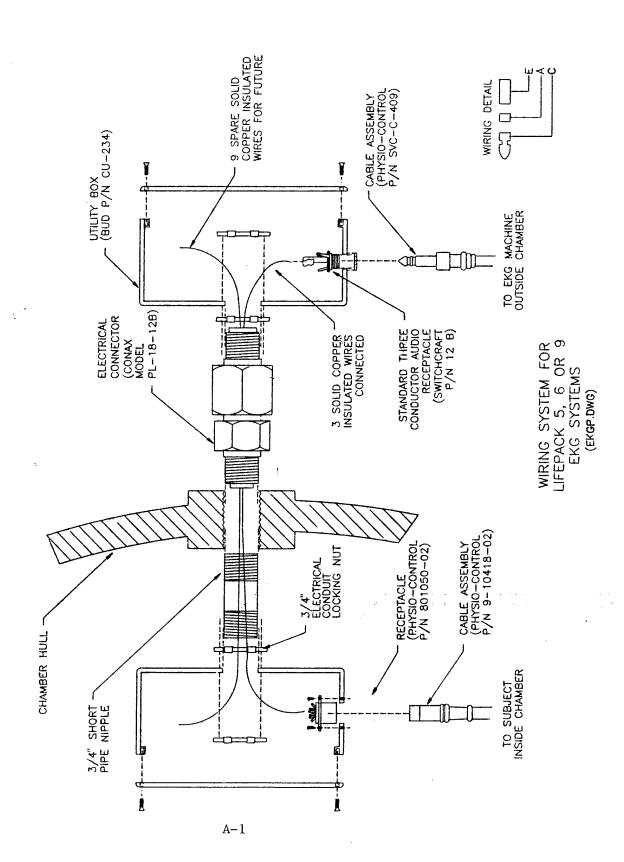


FIGURE 1

#### APPENDIX B

## SUPPLIER SOURCE LIST

Physio Control Company P.O. Box 7006 Redmond, Washington 98073-9706

Newark Electronics Administration Office Ravenwood Ave Chicago, Illinois 60640-4496 312-784-5100 (Phone) 312-638-7652 (Fax)

Amron International
759 Fourth Ave
Escondido, California 92025-4089
619-746-3834 (Phone)
619-746-1508 (Fax)

Any local electrical supply company

Source for all parts listed with Physio Control part numbers

This is the corporate office for Newark Electronics and source 4801 N. for the name, phone number and address of the nearest supplier of Bud Utility Boxes and Switchcraft Receptacles

Source for Conax Connectors

Source for electrical conduit locking nuts and short nipples